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TIBICEN DAVISI Smith and Gosbeck (CICADIDAE) A NEW PEST OF ECONOMIC IMPORTANCE*

By J. W. WILSON

In the September issue of THE FLORIDA ENTOMOLOGIST there appeared an article describing the attack of cicadas upon *Asparagus plumosus*. Since that time we have been able to collect further data on the cicada which is responsible for this damage and it seemed advisable to present this data at this time.

As early as June 27th when the first visit was made to Jupiter large numbers of a small species of cicada *Diceroprocta olympusa* Walker were present in the pine trees and bushes of that vicinity. It was an easy task to capture many males, and a few females were captured. The males are easily located by their loud continuous, monotonous, and unvarying song. A few specimens of this species have been observed and captured in the "fernery", and a few cast nymphal skins have also been collected in the "fernery". On July 10th (the second visit to Jupiter), a different type of cicada song was heard and on August 11th females of this species were observed laying eggs in dead sea oats stems about 100 feet from the beach. Mr. Wm. T. Davis identified this species as *Diceroprocta viridifacia* Walker. None of the adults of this species were observed in the "ferneries" throughout the summer, although there appears to be no reason why this species should not feed on *Asparagus plumosus*. On September 15th the females of this species had disappeared but a few males were heard singing in the brush near by. On August 1st still another cicada song was heard but males of this species were not captured until August 7th. Upon examination Mr. Davis determined that these specimens belonged to the species *Tibicen davisi* Smith and Grosbeck. As

*Contribution from the Department of Entomology, Florida Agricultural Experiment Station.

the season advanced more and more individuals of this species emerged from the fernery each day.

Until September 8th very few females of *T. davisi* were observed emerging. On August 30th 100 cast nymphal cases were collected; only five of these were shed by females. After September 8, large numbers of both sexes emerged each day. The peak of the daily emergence came between September 16th and 30th, but individuals continued to emerge until October 15th.

Since the publication of the article in September cast nymphal skins, which were of a size that indicated that they were *T. davisi* have been collected in "ferneries" at Yalaha, Melbourne, and Boynton. Males of this species were captured in the woods at Pierson, and several growers from various sections of the state report that a few cicada cases have been observed in their "ferneries". But it is only at Jupiter that they have become abundant enough to do noticeable damage.

A large number of males and females were collected and placed in screen cages over *Asparagus plumosus*, but in every case all the specimens died within forty-eight hours. For this reason it has been impossible up to the present to collect data on the time of mating, the length of the preoviposition period, and the length of adult life. Dr. R. H. Beamer working with several species of cicada in Kansas found however, that the adult can be kept alive in cages for long periods of time if the proper food plant is supplied. It seems surprising that the adults of this species do not feed on *A. plumosus* for the young shoots are very tender and succulent. Thinking that my first cage was too small I built a much larger one and placed it over plants with mature nymphs on the roots, but all of the adults which emerged in this cage also died within forty-eight hours. I have not yet observed adults feeding on *A. plumosus*. It seems evident that the adults leave the fernery to feed and mate and the females return to deposit their eggs.

The full grown nymphal cicadas begin emerging from the ground very early in the evening. They crawl upon the nearest support and in many cases travel as much as twenty-five feet before stopping to shed the nymphal case. By ten o'clock many of the adults have already completed the task of shedding the last nymphal skin and may be observed clinging to the plants and supports of the sheds expanding their wings and drying themselves. At sunrise most of the individuals are ready for flight, but very few of them begin flying before about eight o'clock.

The females will deposit their eggs in almost any kind of plant material which they find available. Comparatively few of the eggs are placed in the stems of *A. plumosus*. The females distinctly prefer the dried and seasoned timbers, of which the sheds are constructed, to any other available material. It seems to make little difference whether this material is pine or cypress. The eggs are placed in holes drilled by the stout ovipositor of the female. A series of as many as twenty-five to thirty of these nests will be placed in a row if the laying female is not disturbed. From five to twelve eggs are placed in a single row in each of these nests. The nest may be sealed with a frothy secretion but in most cases it is not sealed in any way. Eggs deposited as early as September 8th have not yet hatched out (November 13th), so it is assumed that this species passes the winter in the egg stage. Beamer reports that many of the cicada belonging to the genus *Tibicen* pass the winter in the egg stage in Kansas.

When the young nymphs hatch out they will be about the same length as the egg which is 2.3 mm. in length. These small nymphs will make their way to the opening of the nest and after casting what Beamer designates as the postnatal skin, they will cast themselves bodily into space. They will immediately make their way to the roots of the plant, form a cell and begin feeding. In June only a few third stage nymphs were found in spite of the fact that most of the soil dug was run through a small meshed screen. Large numbers of fourth stage nymphs and early fifth stage nymphs were collected at this time. The nymphs are usually found about six inches below the surface of the soil directly beneath the crown of the plant. They are never found on *A. plumosus* deeper than eight inches for this is the maximum depth at which this plant produces numbers of roots or crowns. In August, and September, many full grown fifth stage nymphs and some fourth stage nymphs were collected. The full grown fifth stage nymph is recognized by its increased size and the prominent, red eyes. It is assumed that these fourth stage nymphs either pass the winter as such or transform to fifth stage nymphs and pass the winter in this stage.

We have not been working on this problem long enough to assign any definite length of time for the development of any of the immature stages. Any statement as to the length of time required for the development is mere conjecture but evi-

dence seems to indicate that this species does not require longer than three or four years.

During the summer nearly every available insecticide was used in an attempt to control the nymphs in the soil. These included various strengths of calcium cyanide, Black Leaf 40, carbolic acid emulsion, a number of pyrethrum compounds, chloride of lime, kerosene emulsion, Mowrah Meal (a fertilizer somewhat like castor pummace), steam, hot water, carbon disulphide, and carbon disulphide emulsion. Of these carbon disulphide emulsion alone was effective to any extent. The emulsion was made up by a 1-3-10 formula, 1 part fish oil soap, 3 parts water, 10 parts carbon disulphide. This emulsion was then diluted at the rate of one pint to twelve gallons of water. Three pints of this dilute solution was applied to each square foot of soil. This treatment gave a good control for the fourth stage nymphs, but did not have any noticeable effect upon the fifth stage nymphs. If this material is made stronger either by adding more of the concentrated emulsion to the water or by applying more of the solution to each square foot of soil, the plants will die. This treatment will cost about $160.00 per acre for each application.

A very ingenious method of control was used very effectively by Mr. Wilkinson, the grower whose "ferns" were most severely damaged this summer. This control should properly be called the *Hydraulic Pressure Method.* It consists merely of attaching a garden hose at convenient points to the irrigation system and stopping all other openings of the system. A one-quarter inch pipe about three feet long is attached to the end of the hose. By this means he obtained about eighty pounds pressure at the nozzle end. The stream of water is directed into the soil holding the end of the nozzle about two inches from the soil. This stream of water thoroughly cultivates every inch of the soil and penetrates to a depth of about twelve inches or deeper, depending on how long the nozzle is held in one place. Large numbers of the nymphs are rolled out upon the surface and left to dry out and die. Many are hit directly by the stream and torn to pieces. A few of the larger nymphs escape unharmed but all of these emerged as adults in September. Thus in October when we went over a plot of about seventy-five square feet for the second time, it was found that his "fernery" was practically free of the nymphs and will remain free until the next brood of eggs hatches out. Mr. Wilkinson estimates that this treatment will cost about $40 per acre, or

about one-fourth as much as the carbon disulphate emulsion treatment. This treatment has other advantages. By this means the grower is enabled to cultivate the soil which has been impossible heretofore because of the nature of growing *A. plumosus*. Fertilizers can be applied to the top of the soil as has been the practice and washed into the soil. Most of the smaller weeds are destroyed by this means. Mr. Wilkinson also thinks that the treatment noticeably reduced the numbers of the developing brood of noctuidae by destroying many of the pupae in the soil.

In September a number of materials were applied to the shed in an attempt to prevent the females depositing their eggs in the timbers of the "fernery". Bordeaux mixture, various strengths of oil emulsion, lime-sulphur solution, and whitewash were used. Of these the plot upon which whitewash was used was the only one avoided by the females. This was only a small plot and might not prove effective if the whole shed were treated. The whitewash also vastly increases the amount of light in the "fernery", and if used on a large scale lamp black should be mixed with it.

A little later on various strengths of oil emulsions, carbon disulphide and carbon disulphide emulsion, lime-sulphur, and paridichlorobenzene were applied to egg nests. Since none of the eggs have yet hatched it is not possible to determine how effective these treatments will be.

I have not yet collected any egg parasites or nymphal parasites but Beamer reports that there is a large number of both egg and nymphal parasites which attack the Kansas Cicadidae. No doubt some of these also attack *Tibicen davisi* and other Cicadidae found in Florida. A large species of Robber Fly has been observed feeding upon the adult cicadas, but the Robber Fly escaped before I could capture it for identification. A large species of Spider which builds its web in the "fernery" has also been observed feeding upon the adults. A great many of the adults are destroyed by mocking birds, blue jays, and mourning doves. Large flocks of these birds congregate around the ferneries during the period when the adults are emerging. One grower attributed the excessive numbers of cicadas in 1930 to a direct affect of the 1928 hurricane which killed many birds in that region. Skunks, field rats and moles dig up and eat some of the nymphal cicadas but we have no way of determining how many these predators destroy.

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BIOLOGY OF THE MEXICAN COTTON BOLL WEEVIL. VI.
Some Humidity and Temperature Effects on Development and Longevity[1]

By EDGAR F. GROSSMAN

The difficulty encountered in keeping cotton boll weevils (*Anthonomus grandis* Boh.) alive in low temperature incubators equipped with brine coils led to the determination of the optimum range of relative humidity necessary for successful weevil hibernation in artificially cooled environments. In order to secure and maintain a number of constant relative humidities, 200 cc. of varying percents of sulphuric acid and distilled water were placed in desiccators measuring seven inches in diameter. The sulphuric acid solutions were mixed in accordance with data presented by R. E. Wilson.[2]

The specific gravity of each solution was then recorded and subsequent determinations of the relative humidity of each desiccator were obtained by specific gravity measurements. Though the majority of the solutions remained constant, some of them, after being used for a month, varied by one half of one percent relative humidity. Allowances for temperature corrections were not made since the percent relative humidity varied but slightly between 21° C. and 27° C., and the series in which the temperatures were maintained at 15° C. and 2° C., respectively, showed no critical points of interest. Daily aeration of

[1]Contribution from the Department of Cotton Investigations, Florida Agricultural Experiment Stations.

[2]Wilson, Robert E. "Humidity Control by Means of Sulphuric Acid Solutions." Jour. Indus. and Engin. Chem. Vol. XIII, No. 4. pp. 326-29. 1921.

the desiccators eliminated the accumulative carbon dioxide generated by the insects, without noticeably changing the concentration of the sulfuric acid solutions. The following solutions were used:

Specific Gravity	Percent Sulfuric Acid	Approximate Relative Humidity
1.000	.00	100
1.039	6.00	98
1.080	12.00	95
1.124	18.00	90
1.163	23.00	85
1.202	28.00	79
1.243	33.00	70
1.286	38.00	61
1.321	42.00	53
1.366	47.00	43
1.405	51.00	35
1.435	54.00	29
1.477	58.00	21
1.520	62.00	14
1.565	66.00	9
1.599	69.00	6
1.646	73.00	3
1.681	76.00	2
1.716	79.00	1

Boll weevils freshly captured in a nearby cotton field were confined in small galvanized iron wire mesh cages to avoid the possibility of having the weevils fall into the sulfuric acid solutions. The cages were then placed in nineteen desiccators which were maintained at the specified relative humidities. The information presented in Table I is self-explanatory, the optimum range extending from 61 percent to 98 percent relative humidity for 27° C.; from 21 percent to 100 percent for 15° C.; and from 9 percent to 100 percent for 2° C. A decrease in temperature apparently minimizes the lethal effect which a low percent humidity exercises on adult boll weevils, whereas increased temperatures tend to narrow the range of optimum relative humidity.

Additional experiments were conducted with adult weevils in order to determine, by examination of the desiccators at two-day intervals, the longevity of weevils maintained at 27° C. over a range extending from 6 percent to 100 percent relative humidity, and also at 21° C. over a range extending from 1 percent to 100 percent relative humidity. Two sets of desiccators were

used for each temperature experiment, fresh cotton squares being supplied the weevils in one set and no food at all being supplied the weevils in the other set. A study of Tables II and III shows that, with the possible exception of relative humidities below 35 percent, both at 27° C. and 21° C., respectively, the presence of food increased the period of time through which adult weevils live. As in Table I, a decrease in temperature is accompanied by a widening of the range of the relative humidities which are non-lethal to the adult. An additional factor is the longevity records of weevils confined in desiccators maintained at 21° C., where a large number of weevils lived longest between 79 percent and 98 percent relative humidity, one weevil living over 161 days at 95 percent relative humidity. A large number of weevils confined at 13° C. with a range of relative humidity extending from 70 percent to 85 percent lived over 300 days, one weevil living 359 days under such conditions. When the relative humidity was maintained at 60 percent or less, weevils did not live so long, dying rapidly when 35 percent or less was reached.

In order to determine the range of optimum percents of relative humidity required for boll weevil transformation, fresh cotton squares into which boll weevils had oviposited were placed into desiccators daily. The egg-laden squares were kept at 21° C. and 27° C., respectively, the range of relative humidity extending from 1 percent to 100 percent in each of the two temperatures. The effect of the various relative humidities was more marked on the weevil transformation than on the adults. At 27° C. the range of non-lethal humidities was definitely restricted to limits extending from 21 percent to 95 percent relative humidity. At 21° C. the range widened. Though the boll weevil eggs developed into adults in a relative humidity as low as 21 percent and as high as 95 percent, the most rapid development at 27° C. took place at 79 percent and 85 percent relative humidity. (See Table IV.) Other tests conducted at the same temperature yielded similar results.

Again, when the temperature is kept constant at 21° C., the most rapid transformation takes place at 79 percent and 85 percent relative humidity. (See Table V.) A noticeable break occurs when the humidity drops below 21 percent, though several weevils managed to escape from the squares at 1, 3 and 6 percents, respectively. A large number of live weevils remained in the hardened, dry squares at 21° C., while none were found in

the series kept at 27° C. Both series, however, yielded but few live pupae and relatively few live larvae.

Boll weevil transformation at 27° C. is completed in an average of 12 days when the relative humidity is kept within a 70 percent to 90 percent limit. Above or below this range the transformation is retarded. At 21° C. the transformation is completed in an average of 21 days in the same range, higher or lower percents relative humidity retarding the transformation. For a period extending over several days adult weevils can withstand any percent relative humidity between 1 percent and 100 percent, though an optimum range limited to 61 percent low and 98 percent high is necessary for continued activity.

TABLE I.—Percent Adult Boll Weevils Surviving Confinement in Desiccators in Which Various Constant Temperatures and Humidities Were Maintained.

Approximate Relative Humidity	Not in Incubator 27° to 33° C., 1 Day 30 Weevils	Not in Incubator 27° to 40° C., 2 Days 30 Weevils	Incubator 27° C., 5 Days 15 Weevils	Incubator 27° C., 5 Days 15 Weevils	Incubator 27° C., 6 Days 15 Weevils	Incubator 27° C., 8 Days 30 Weevils	Incubator 27° C., 8 Days 40 Weevils	Incubator 27° C., 10 Days 30 Weevils	Incubator 15° C., 7 Days 15 Weevils	Incubator 15° C., 10 Days 25 Weevils	Incubator 15° C., 15 Days 30 Weevils	Incubator, 15° C., 1 Day 2° C., 15 Days 30 Weevils	Incubator, 15° C., 1 Day 2° C., 22 Days 8 to 30 Weevils
100	10.00	0	60.00	40.00	86.67	43.33	95.00	63.33	60.00	96.00	83.33	66.67	60.00
98	50.00	33.33	66.67	33.33	60.00	70.00	85.00	53.33	93.33	92.00	56.67	66 67	50.00
95	43.33	0	60.00	40.00	66.67	33.33	77.50	76.67	93.33	60.00	63.33	96.67	31.03
90	33.33	0	40.00	40.00	93.33	30.00	47.50	53.33	100.00	76.00	80.00	46.67	71.43
85	66.67	0	46.67	40.00	73.33	33.00	67.50	70.00	86.67	80.00	70.00	26.67	62.50
79	23.33	0	33.33	46 67	40.00	46 67	47.50	70.00	86.67	72.00	70.00	53.33	43.75
70	43.33	0	33.33	46.67	86.67	33.33	35.00	70.00	73.33	76.00	66.67	70.00	23.80
61	6.67	0	33.33	26.67	66.67	30.00	35.00	60.00	86.67	100.00	66.67	43.33	69.23
53	43.33	0	33.33	20.00	20.00	10.00	2.50	40.00	66.67	76.00	66.67	33.33	40.00
43	40.00	0	0	13.33	26.67	23.33	5.00	46.67	53.33	60.00	53.33	30.00	11.11
35	0	0	0	20.00	0	0	2.50	40.00	53.33	36.00	26.67	26.67	37.50
29	3.33	0	13.33	13.33	33.33	0	0	20.00	73.33	28.00	23.33	40.00	33.33
21	20.00	0	26.67	20.00	46.67	0	0	13.33	60.00	40.00	33 33	26.67	12.50
14	3.33	0	0	13.33	0	0	0	10.00	60.00	32.00	13.33	40.00	25.00
9	0	0	13.33	0	0	0	0	13.33	46.67	4.00	23.33	20.00	0
6	43.33	0	6.67	0	20.00	0	0	0	53.33	52.00	10.00	13.33	0
3	0	0	0	6.67	0	0	0	0	60.00	44.00	23.33	33.33	0
2	20.00	0	6.67	0	33.33	0	0	3.33	33.33	28.00	10.00	33.33	0
1	13.33	0	0	0	20.00	0	0	0	60.00	36.00	13.33	20.00	50.00

TABLE II.—Longevity of Adult Boll Weevils Confined in Desiccators Maintained at 27° C. and Varying in Relative Humidity from 6 to 100 Percent. Fifty Weevils were Placed in Each Desiccattor, the Number Living Being Recorded at Two Day Intervals.

Approximate Relative Humidity	Food Supplied Weevils — Number Days															No Food Supplied Weevils — Number Days						
	1	3	5	7	9	11	13	15	17	19	21	23	25	27	29	1	3	5	7	9	11	13
100	23	19		19	16	14	9		4	3		2			0	13	5		1	0		
98	44		39	28	15	8		3	1		0					10	0					
95	45		29	20	13	7		7	5		1			0		36		16	4	0		
90	40		31	25	19	12		10	9		3			0		38		4	2	0		
85	41	34	30		28	24	22	21			14			0		39	12	5		0		
79		49	44	38	22		21	21		4			0				48	18	6	1		0
70		48	23	12	7		7	7		0							33	15	1	0		
61	46	39	34		28			3			0						45		13	0		
53		46	39		31			3			0						40		8	0		
43		48	38		14			0									29	1		0		
35		41		15	8			0									4		0			
29		47		36	25			1			0						19		0			
21		44		36	30			0									11		0			
14		9	1				0										2					0
9		5	0														6	0				
6		21	0														2	0				

TABLE III.—Longevity of Adult Boll Weevils Confined in Desiccators Maintained at 21° C. and Varying in Relative Humidity from 6 to 100 Percent. Fifty Weevils were Placed in Each Desiccator, the Number Living Being Recorded at Stated Intervals.

Approximate Relative Humidity	Food Supplied Weevils — Number Days						No Food Supplied Weevils — Number Days		
	4	31	46	55	83	161	5	31	46
100	39	17	5	2	0				
98	48	28	21	17	3	0			
95	50	26	19	15	8	1			
90	46	12	5	4	1	0			
85	36	15	9	6	1	0			
79	39	16	14	12	3	0			
70	39	9	4	1	0				
61	45	11	1	0					
53	35	5	0				30	0	
43	35	3	0				41	0	
35	39	1	0				44	0	
29	32	0					38	4	0
21	33	0					40	0	
14	31	0					37	0	
9	24	0					50	0	
6							41	0	
3							43	0	
2	1	0					41	0	
1	23	0							

TABLE IV.—Boll Weevils Hatching from Eggs Laid in Fresh Cotton Squares Maintained at 27° C. but Subjected to Various Percents Relative Humidity.

Approximate Relative Humidity	Number Squares	Number Weevils Hatched and Number of Days Required								Number Additional Forms Found					
		Days								Adults		Pupae		Larvae	
		11	12	13	14	15	16	17	18	Live	Dead	Live	Dead	Live	Dead
100	17									0	0	0	0	0	17
98	19									0	0	0	0	0	19
95	21		3							0	0	0	0	0	18
90	21			3	1					0	0	0	1	0	16
85	20	1	1	3						0	0	0	0	0	15
79	19	1	5	1						0	0	0	1	0	11
70	23		5	1		1				0	0	0	0	0	16
61	22			2						0	0	2	0	0	18
53	21		1	1		3				0	0	0	0	3	13
43	21							2		0	1	0	0	2	16
35	19				2					0	0	0	0	3	14
29	20			1						0	1	0	0	3	15
21	37								3	0	3	0	0	11	20
14	22									0	4	0	0	2	16
9	23									0	0	0	0	2	21
6	26									0	2	0	0	0	24
3	29									0	5	0	0	4	20
2	19									0	0	0	0	0	19
1	25									0	0	0	0	0	25

TABLE V.—Boll Weevils Hatching from Eggs Laid in Fresh Cotton Squares Maintained at 21° C., but Subjected to Various Percents Relative Humidity.

Approximate Relative Humidity	Number Squares	Number Weevils Hatched and Number of Days Required														Number Additional Forms Found					
		19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	Adults		Pupae		Larvae	
																	Live	Dead	Live	Dead	Live	Dead
100	38			2			1	2	7	1	2		1				0	0	0	4	0	18
98	63			1	1	3	6	7	1								0	1	0	4	0	39
95	61			2		3	10	5	2			1					0	0	0	2	0	36
90	60		1	1	2	13	1		1								0	0	0	7	0	34
85	68	1	1	20	10	9	3	1	1								0	1	0	4	0	17
79	71			14	10	5	4	7	2								2	1	0	2	4	20
70	49					1		2		2	1	2		1			1	0	0	1	2	36
61	53		1	2			1	1		7	2	1		1	1		0	1	1	2	4	28
53	53				1	2											1	1	2	3	4	39
43	71							5	9	2	4						5	3	1	0	4	38
35	69					2	4	6	8	4	2	1	2	1			0	1	0	0	2	36
29	83			1	6	2	6	1	6	1		1					4	10	1	0	4	40
21	56										2	14	7		2		2	0	1	1	0	27
14	50																2	0	0	0	0	48
9	50																10	2	0	0	4	34
6	67					6			1				1				3	9	0	0	0	47
3	77													1	2	1	24	5	0	5	6	33
2	60																0	0	0	0	0	60
1	49									2			1				5	5	0	2	1	33

TIME OF HATCHING FIRST GENERATION BOLL WEEVILS RELATIVE TO APPEARANCE OF BLOSSOMS[1]

By PAUL CALHOUN

Timeliness is a factor of first importance in the application of poisons to control the cotton boll weevil. Applications made too soon are partially wasted; those made too late fail in a measure—a very large measure at times—to accomplish their purpose. An example of this is found in allowing first generation weevils to hatch in sufficient numbers to puncture a considerable percentage of the young bolls before making dust applications in those cases where the hibernated weevils were not poisoned when the cotton was small.

In order to be able to predict with some degree of assurance when one should expect first generation weevils to hatch where hibernated weevils are not poisoned, the pre-bloom period during which the first generation of weevils could normally be rearing was determined for an Upland and a Sea Island variety of cotton and correlated with the period required for a weevil to hatch in the field. About 450 squares were measured and tagged on Lightning Express 15-23 (Upland) and Seabrook (Sea-Island) varieties. This was done from May 29 to June 6, while the plants were in the pre-bloom stage. The time elapsing between the date of measuring the squares and the date of blossoming was recorded in each case. The average time required for each size measured to blossom is shown graphically in Chart A, while Tables I and II show more complete data for the sizes of chief interest from the standpoint of possible producers of first generation weevils. It can be seen from the tables that most of the blossoms occur within two days of the average calculated.

G. D. Smith* determined that the average time required from egg to adult under field conditions at Madison, Florida, was between 21 and 22 days. As the temperatures at Madison differ but little from the temperatures of the greater part of the Florida cotton belt, these figures may be considered sufficiently correct for all practical purposes for the principal cotton growing areas of the state.

Referring to Chart A, it is evident that for a weevil to hatch in an upland field before blossoming time it will have to develop

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[1]Contribution from the Dept. of Cotton Investigations, Fla. Agric. Experiment Sta.

*Bulletin 926, U. S. D. A. (1921) G. D. Smith.

TABLE I.—Time Required for Upland Squares of Various Sizes to Bloom.

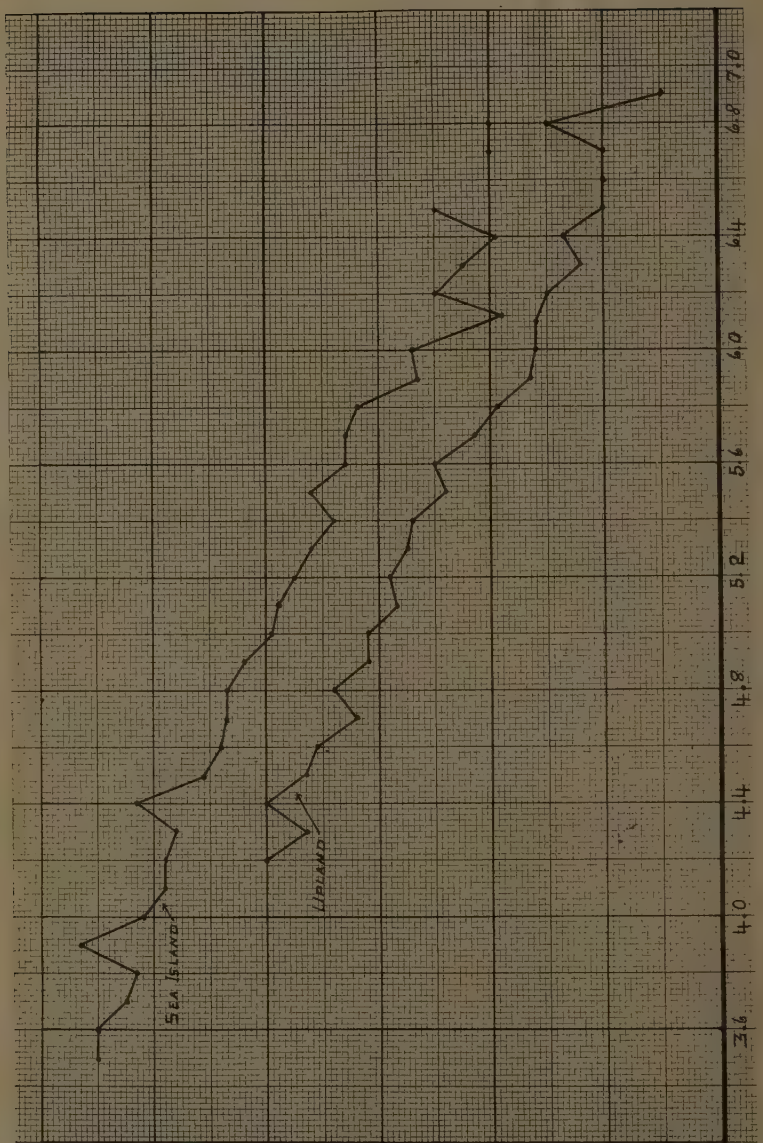
Diameter in Millimeters	Number Measured	Percent Blooming in Days											Average, Days
		14	15	16	17	18	19	20	21	22	23	24	
4.5	18							22	44	22	6	6	21.3
4.6	11						9	37	18	18	9	9	21.1
4.7	12							58	42				20.4
4.8	25							40	44	12		4	20.8
4.9	22						16	54	25	5			20.2
5.0	43				6		16	44	16	16		2	20.2
5.1	16			6	6		31	38	19				19.7
5.2	19						52	26	16		6		19.8
5.3	25					8	48	32	12				19.5
5.4	31				3	10	36	45	6				19.4
5.5	28			7	7	14	50	18	4				18.8
5.6	20				5	25	40	25	5				19.0
5.7	19		6	16	6	19	36	11		6			18.3
5.8	34		5	12	18	35	18	9	3				17.9
5.9	14		14	9	28	28	21						17.3
6.0	34	6	6	24	15	29	18	2					17.2

TABLE II.—Time Required for Sea Island Squares of Various Sizes to Bloom.

Diameter in Millimeters	Number Measured	Percent Blooming in Days									Average Days
		17	18	19	20	21	22	23	24	25	
4.5	18						28	39	28	5	23.1
4.6	16						25	56	19		22.8
4.7	17					6	29	53	12		22.7
4.8	10						40	50	10		22.7
4.9	9						67	22	11		22.4
5.0	20					25	65	10			21.9
5.1	5				20	20	20	40			21.8
5.2	12					58	33	9			21.5
5.3	16				18	38	44				21.2
5.4	10			10	30	30	30				20.8
5.5	15				13	66	8	13			21.2
5.6	12		8		25	33	25	8			20.6
5.7	9		11		11	78					20.6
5.8	17			12	41	41		6			20.4
5.9	3		33	33		33					19.3
6.0	8	12	25	12	12	39					19.4

from rather small squares. In the variety tested they would have to develop in squares of about 4.5 millimeters diameter at the time of oviposition. Weevils do not ordinarily develop in smaller squares than this, as very small squares dry so readily after they fall from the plants that the larvae they contain die. On the other hand, it appears that first generation weevils find no difficulty in hatching within three or four days after first

CHART A.—Time Required for Squares to Bloom.



blossoming time, as squares of from 5.5 to 6.0 millimeters diameter easily produce adult weevils except under unfavorable weather conditions. Although Lightning Express 15-23 was the only Upland variety tried, it is not probable that other standard Upland varieties would show sufficient differences in the pre-bloom period as measured to be of importance in weevil control operations. Earliness has been one of the aims of most cotton breeders for years, therefore, considerable uniformity is to be expected in this regard. Some of the Sea-Island strains, however, possibly would have a pre-blossom weevil breeding period sufficiently long to permit first generation weevils to begin to hatch several days before first blossoming.

Most growers do not realize that first generation weevils can begin hatching so early. In fact, ordinarily they do not hatch that early in sufficient numbers to cause damage, as generally a large percentage of the eggs first laid never produce weevils, because many of the immature stages are killed by the hot sunshine prior to the time the cotton is large enough to furnish sufficient protective shade. On the contrary, if rainy weather predominates from the time infested squares begin to fall, and no hot sunny weather occurs, first generation weevils begin to hatch in an infested field by the time blossoms appear, or very shortly afterward. In this case they may easily become numerous enough to puncture many of the young bolls within three weeks after the first blossoms occur.

NOTES ON UTAH COLEOPTERA

GEO. F. KNOWLTON

(Continued from page 56)

Stenocorus vestitus Hald.
Logan, August 13, 1921 (G. E. King).

Leptacmaeops subpilosa (Lec.)
Bountiful, 1929 (Pack); Cache Junction, June 3, 1912 (Hagan); Logan, July 4, 1909 (Titus); Logan Canyon.

Acmaeops longicornis Lec.
Maryvale, June 25, 1906.

Leptura chrysocoma Kby.
Logan, July 30, 1904.

Typocerus velutina (Oliv.)
Logan, July 27, 1928 (Pack).

Rosalia funebris Mots.
Lewiston.

Callidium pseudotsuga Fisher
Logan, May 16, 1921 (G. E. King).

Phymatodes dimidiatus (Kby.)
Logan, June 28, 1904.

Oxoplus jocosus Horn
Fort Duchesne, August 13, 1926 (W. Sorenson); Mt. Pleasant, August 20, 1929 (Pack).

Crossidius pulchellus Lec.
Blacksmith Fork Canyon, August 17, 1929 (Knowlton).

Crossilius discoideus (Say)
Logan, August 21, 1927 (Knowlton) and Sept. 11, 1907.

Hyperplatys maculata Hald.
On cherry tree at Provo Bench, June 26, 1921 (G. E. King).

Pogonocherus parvulus Lec.
Logan, July 30, 1904.

Saperda populnea (L.)
Salinas, California, April 26, 1908 (Ball).

Saperda concolor Lec.
Logan, June 19, 1923 (Knowlton); reared from poplar, April 11, 1920 (G. E. King).

Mecas bicallosa Martin
Pleasant Grove, June 21, 1929 (Pack).

Tetraopes femoratus Lec.
Logan, July 3, 1923 (Knowlton). Also collected at Stanrod, Idaho, August 13, 1929 (Knowlton).

Family CHRYSOMELIDAE

Donacia pusilla Say
Hyde Park, May 16, 1929 (Knowlton).

Griburius montezuma (Suffr.)
Bellevue, 1919.

Chrysochus cobaltinus Lec.
Hooper, September 1929 (Knowlton); St. George, 1919.

Zygogramma exclamationis (Fab.)
Salt Lake City, 1924; St. George, 1919.

Lina scripta (Fab.)
Watson, July 1927 (Pack).

Monoxia consputa (Lec.)
Ephraim, October 9, 1907 (Ball); on beets at Brigham, 1925 (Knowlton).

Diabrotica 12-punctata var. **tennella** Lec.
St. George, 1923 (Hawley).

Disonycha quinquevittata (Say)
On rose at Spring Hollow, Logan Canyon, August 1925 (Knowlton).

Epitrix subcrinita Lec.
Common on beets at Logan, July 27, 1929 (Knowlton); Marysvale, June 29, 1906 (Ball); Sigurd, March 3, 1928 (Knowlton); Sutherland, March 4, 1928 (Knowlton).

Systena taeniata (Say)
Common on Sugar-beets at Hyrum, September 2, 1926 (Knowlton); Lehi, July 23, 1907 (Titus); Mendon, July 16, 1907 (Titus); North Ogden, June 7, 1929 (Knowlton); Wellsville, June 1929 (Knowlton).

Psylliodes punctulata Melsh.
Common on sugar-beets at Amalga, May 27, 1924 (Knowlton); Delta, July 12, 1926 (Knowlton); Lehi, July 23, 1927 (Knowlton); Lewiston, June 24, 1924 (Knowlton); Logan, June 20, 1907; also collected at Whitney, Idaho, August 1, 1907.

Chelymorpha cassidea (Fab.)
Logan, June 18, 1923 (Knowlton).

Family MYLABRIDAE

Mylabris pisorum (L.)
Logan, September 1923 (Knowlton); Ogden, March 28, 1923 (Knowlton), Providence, April 1, 1929 (Pack).

Mylabris obtectus Say
On beans, Tooele, 1916.

(To be continued)

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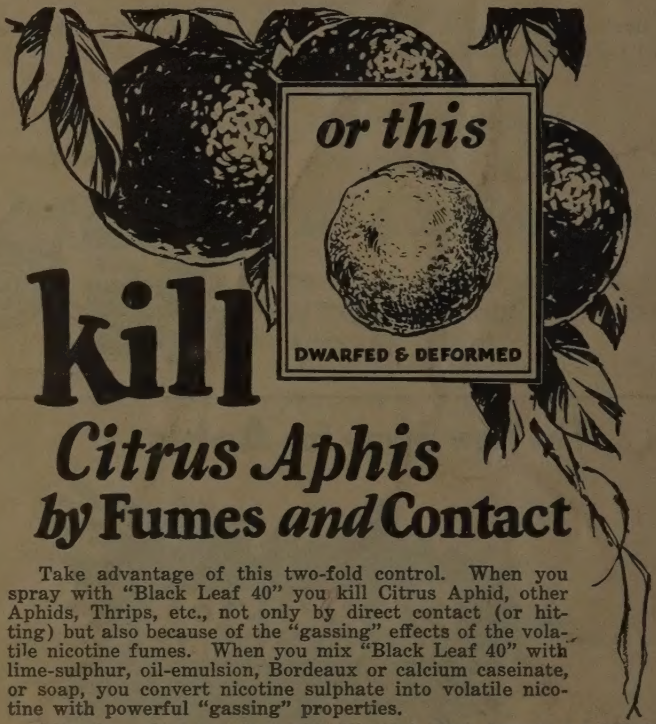

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